FYI ...a Fluor Hanford publication for employees
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New groundwater contamination barrier to be tested

The Site's Groundwater Remediation Project (GRP), managed by Fluor Hanford, is implementing a test plan and drilling 12 wells to support an innovative new method of binding strontium 90 (Sr-90) contamination in groundwater at the 100 N Area, and preventing the contamination from reaching the Columbia River. Known as the "sequestration barrier," the initial 300-foot chemical barrier should be operational by March. Sequestration means that the Sr-90 will be chemically bound up, restrained or held until substantial radioactive decay can take place.

The new approach will pump a form of calcium, along with phosphate, into the soil in the 100 N Area to form a compound called apatite. The calcium compound, similar to that found in tooth enamel, will react with the phosphorus to create an apatite barrier in the soil itself. Then, hopefully, a chemical reaction between the Sr-90 and the apatite will bind the strontium in place for decades, keeping it from the river while radioactive decay renders it nearly harmless. Explained at a large stakeholder workshop in October, the new method received overwhelming approval for implementation.

"Everybody got on board," said Russ Fabre, Fluor Hanford's field implementation manager for the 100 N Area sequestration barrier. "This new plan is the epitome of what we're trying to do here at Hanford. Contractors, stakeholders, regulators and the client [the Department of Energy – DOE] are all taking a very dynamic approach, and looking at new ideas to fit our unique situations. It's exciting to be part of this effort."

The 100 N Area, snugged between the 100 D and 100 K Areas near the northern "horn" of the Site, is home to the most massive production reactor ever built at Hanford. The New Production Reactor (NPR – shortened to N Reactor), built in response to the launch of Sputnik by the former Soviet Union in 1957, took nearly six years to build. It operated longer than any of Hanford's other production reactors (23 years, beginning in 1963), and its fuel assemblies were over eight times the size of the fuel used in other Hanford reactors.

N Reactor also produced electric power, and for most of the 1970s, it irradiated its slightly enriched fuel loads for weeks to months longer than fuel is normally irradiated for weapons production. In addition, N Reactor's main cooling water loop recirculated its cooling water several times before discarding it, and later environmental upgrades converted the reactor's smaller, secondary cooling loops to recirculating systems. Cooling water was discharged to the giant, zigzagging 1325 N crib and trench, and allowed to percolate slowly through the soil to groundwater and the Columbia River.

File Photo

President John F. Kennedy (above) dedicated N Reactor (below) Sept. 23, 1963.

All of these factors combined to produce a large plume of Sr-90 in the soil and groundwater in 100 N Area. Sr-90 is harmful to living organisms because it migrates to or "seeks" bone, replacing calcium in bones and weakening or sickening the organisms (humans as well as animals) it enters. In the 100 N Area, strontium is present in groundwater at levels more than one thousand times those allowed in drinking water, and is found in river plants and clams. Unique underground formations along the river shore create springs (known as the N Springs) that almost propel Sr-90 contamination into the current.

The battle to prevent Sr-90 from reaching the Columbia River began in 1995. However, pump-and-treat systems there have removed far less Sr-90 than is naturally removed by radioactive decay. By 2003, the DOE deemed the 100 N pump-and-treat system ineffective.

The problem was that, while pump-and-treat systems can remove Sr-90 from groundwater itself, the 100 N Area groundwater repeatedly experienced recharge (re-contamination) from Sr-90 bound up in the vadose zone (soils and other substrata between the ground surface and the groundwater). Strontium has a high "Kd" factor – or partitioning coefficient – it binds up in the soil matrix more readily than do other minerals under other conditions.

When pump-and-treat systems in the 100 N Area proved inefficient, an underground sheet-metal barrier system was tried. However, when workers attempted to drive the 30-foot sheet pilings into 100 N soils, they hit buried boulders in the soil and the pilings bent. The idea of freezing the underground aquifer at 100 N Area was evaluated, but found to be impractical.

Tasked last year with developing additional ideas for treatment, scientists at the Pacific Northwest National Laboratory (PNNL), and others in the integrated GRP, looked at the apatite sequestration idea. A laboratory bench test at PNNL yielded positive results.

In a unique twist to be implemented in the 100 N Area, the calcium will be coated with citrate – almost candy-coated – before it is mixed with the phosphorus. This coating will slow the reaction between the two chemicals, slowing the formation of the apatite. Bacteria in the soil will have to eat away the citrate before the chemical reaction can take place. GRP scientists and engineers want the chemicals to spread throughout the aquifer, diffusing far and wide, before the apatite forms. That way, the apatite barrier can affect more of the aquifer.

In the first test, being implemented now, the chemicals will be injected only in a 300-foot (horizontal) strip of the relatively high underground strata known as the "Hanford formation." If results are positive, then next spring and summer, the chemicals will be injected deeper, into a 300-foot horizontal strip of strata known as the "Ringold formation." If success is achieved at both levels, the apatite sequestration barrier will be extended to a longer horizontal band throughout the 100 N Area. ■

Michele Gerber, Communications